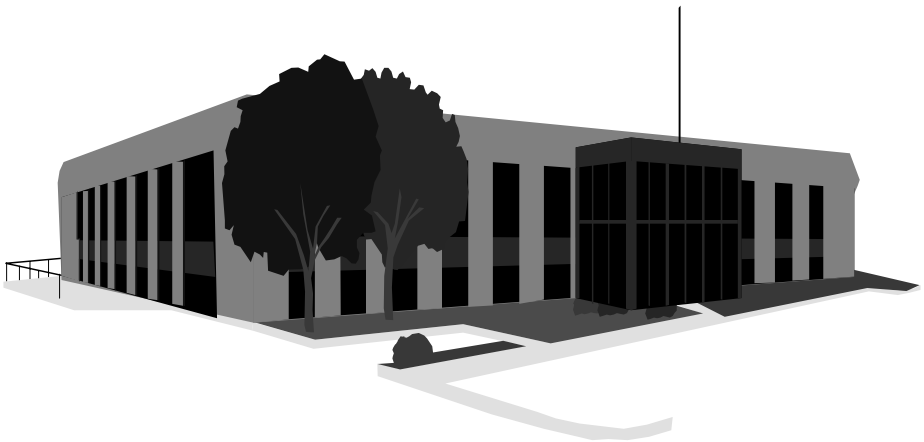
INDOOR AIR QUALITY ASSESSMENT

Salemwood Elementary School
529 Salem Street
Malden, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of a parent, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Salemwood Elementary School, 529 Salem Street, Malden, Massachusetts. Concerns about odors generated from the new gymnasium floor and chemical storage issues prompted this inspection.

On July 25, 2000, a visit was made to the school by Cory Holmes, Environmental Analyst for BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) program, and Suzan Donahue, BEHA Research Assistant, to conduct an indoor air quality assessment. BEHA staff was accompanied on this visit by Chris Webb, Malden Board of Health and Edward Memmolo, Plumbing and Gas Inspector for the City of Malden.

The school is a four-story brick building constructed in 1998-1999. The building has just completed its first academic school year (1999-2000). The school contains general classrooms, science classrooms, kitchen, cafeteria, media center, special education classrooms, gymnasium and office space.

The building was previously evaluated by the Massachusetts Department of Labor and Workforce Development; two reports were issued November 16, 1999 and December 14, 1999 (MDLWD, 2000a; MDLWD, 2000b). In the November report testing was conducted in the main school building and in the gymnasium where complaints of foul odors were reported from the new gymnasium floor. Testing for volatile organic compounds (VOCs) and isocyanates were conducted using charcoal tubes and sent to an American Industrial Hygiene Association (AIHA) accredited lab for analysis. The sampling and analysis were conducted using NIOSH methods, which included a gas chromatography (GC) scan to identify specific contaminants. These testing methods are

described in Appendix A (MDLWD, 2000c). No significant levels of VOCs or isocyanates were found. MDLWD staff did, however note the presence of a mastic-like odor which had accumulated in the gym reportedly due to poor ventilation. The report recommended: 1) the increase of both supply and exhaust ventilation [see Pictures 1 & 2]; 2) that the system be run 24 hours a day until odors have dissipated; 3) that all exhaust fans be in good working order; 4) that a preventive maintenance program be instituted for all AHUs and exhaust fans; 5) that improved communications be developed to address IAQ concerns; 6) that proper procedures be taken in completion of the gymnasium flooring project; and 7) that the school develop an IAQ management plan.

The December MDLWD report concentrated specifically on general indoor air quality concerns in the A-building, C-building and administration offices. The report recommended: 1) the provision of additional outdoor air in classrooms with elevated carbon dioxide [i.e., >800 parts per million (ppm)]; 2) that a preventive maintenance program be instituted for all AHUs and exhaust fans; 3) that all exhaust fans be in good working order; 4) the use of windows to provide supplementary ventilation; 5) that sources of water penetration be remediated and water damaged materials be replaced; 6) maintain floors and carpeting to improve dust control; 7) that improved communications be developed to address IAQ concerns; 8) that proper procedures be taken in completion of the gymnasium flooring project; and 9) that the school develop an IAQ management plan.

Methods

Tests for temperature and relative humidity were taken with the Mannix, TH Pen PTH8708 Thermo-Hygrometer. Screening for total volatile organic compounds

(TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID). Outdoor background TVOC measurements were taken for comparison to indoor levels.

Results and Discussion

The ventilation was shut down at approximately 6:00 PM on July 24, 2000. The school ventilation system was deactivated to allow for any present TVOCs to accumulate within the building. Without dilution and removal by the ventilation system, contaminants present should be at their peak concentration. Under these conditions, TVOC concentrations were measured in an indoor environment that should represent worst case scenario (highest, undiluted TVOC air levels). BEHA staff took background samples in a number of outside locations to account for various environmental conditions (e.g., traffic, weather, etc.) on each side of the building. Screening was conducted in a number of areas with a focus on storage spaces containing janitorial supplies, science classrooms and the gymnasium. The ventilation system was then restarted, and a second round of testing was conducted in areas that had been sampled earlier (see Tables).

TVOC readings within the gymnasium were found to be equal to or below levels measured outdoors in all occupied areas surveyed. While these results suggest that no interior source is creating a build up of pollutants, there was a slightly pungent odor noted in the gym area. The odor was described by several building occupants as a "new shower curtain" type odor, which was believed to be from hanging dividers used to section off the gym (see Picture 2). No measurable levels of TVOCs were recorded in the area of this material.

Measurable levels of TVOCs were found in other areas of the building. This was likely due to a number of activities being conducted throughout the building including the stripping and waxing of floors. Once the ventilation system was reactivated measurable levels of TVOCs were significantly reduced in all areas (see Tables).

Temperature readings in the school ranged from 69^{o} F to 73^{o} F, which was close to the BEHA recommended range for comfort. The BEHA recommends that indoor air temperatures be maintained in a range between 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 62 to 71 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The outdoor relative humidity the day of the assessment was 74 percent. As mentioned previously, the mechanical ventilation system was deactivated. With the combination of inactive ventilation systems and high relative humidity outdoors, relative humidity levels can become elevated indoors. The school is equipped with air conditioning which, when activated serves to remove moisture from the outside air.

Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Other Concerns

A number of other conditions were noted during the assessment, which can affect indoor air quality. A space was noted beneath the boiler room door (see Picture 3). Air currents created by temperature and pressure differentials can allow particulates/odors to migrate into adjacent areas of the school through this space. The school's boilers were not operating at the time of the visit and no odors were detected during the assessment.

Concerns regarding the storage conditions of janitorial cleaning supplies were expressed. BEHA examined a number of janitorial closets and found them to be clean and well organized. Typical cleaning agents are dispensed in a pre-measured amount by a self-contained wall-mounted unit (see Picture 4). This method eliminates waste, spillage and misuse. TVOC readings in these areas were found to be equal to or below levels measured outdoors.

Several stained ceiling tiles were also noted in classrooms, which can indicate leaks from either the roof or plumbing system. Water-damaged ceiling tiles can provide a source for mold growth and should be replaced after a water leak is discovered. Classroom C-309 had an abandoned aquarium containing standing water that appeared to be white and cloudy with mold/algae growth (see Picture 6). Aquariums, if not in use, should be properly emptied and cleaned to prevent mold/bacterial growth and/or unpleasant odors.

The janitorial supply room (A-117) on the first floor contained a number of 1-gallon containers of hydrochloric acid (see Picture 7). All containers were sealed and no odors were noted. According to school staff these containers belong to the general contractor and were being stored in the locked supply area temporarily.

Conclusions/Recommendations

In view of the findings at the time of this visit, the following short-term recommendations are made:

1. Implement the corrective actions recommended as prescribed in MDLWI Reports (MDLWD, 2000a; MDLWD, 2000b).
2. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of thermostat control.
3. Continue to operate gymnasium ventilation system to remove odors associated with vinyl dividers.
4. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
5. Have a complete inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers. Be sure all materials are labeled clearly.
6. Install weather-stripping on bottom of boiler room door to prevent the migration of odors/particulates into occupied areas.

7. Repair roof/plumbing leaks. Replace any remaining water-stained ceiling tiles and pipe insulation. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
8. Change filters for air handling equipment as per the manufacturer's instructions or more frequently if needed.
9. Clean and maintain aquariums to prevent mold/algae growth and associated odors. If not in use empty and disinfect using an appropriate antimicrobial.
10. If hydrochloric acid is stored in the supply room for an extended period of time, consider obtaining an acid storage cabinet.

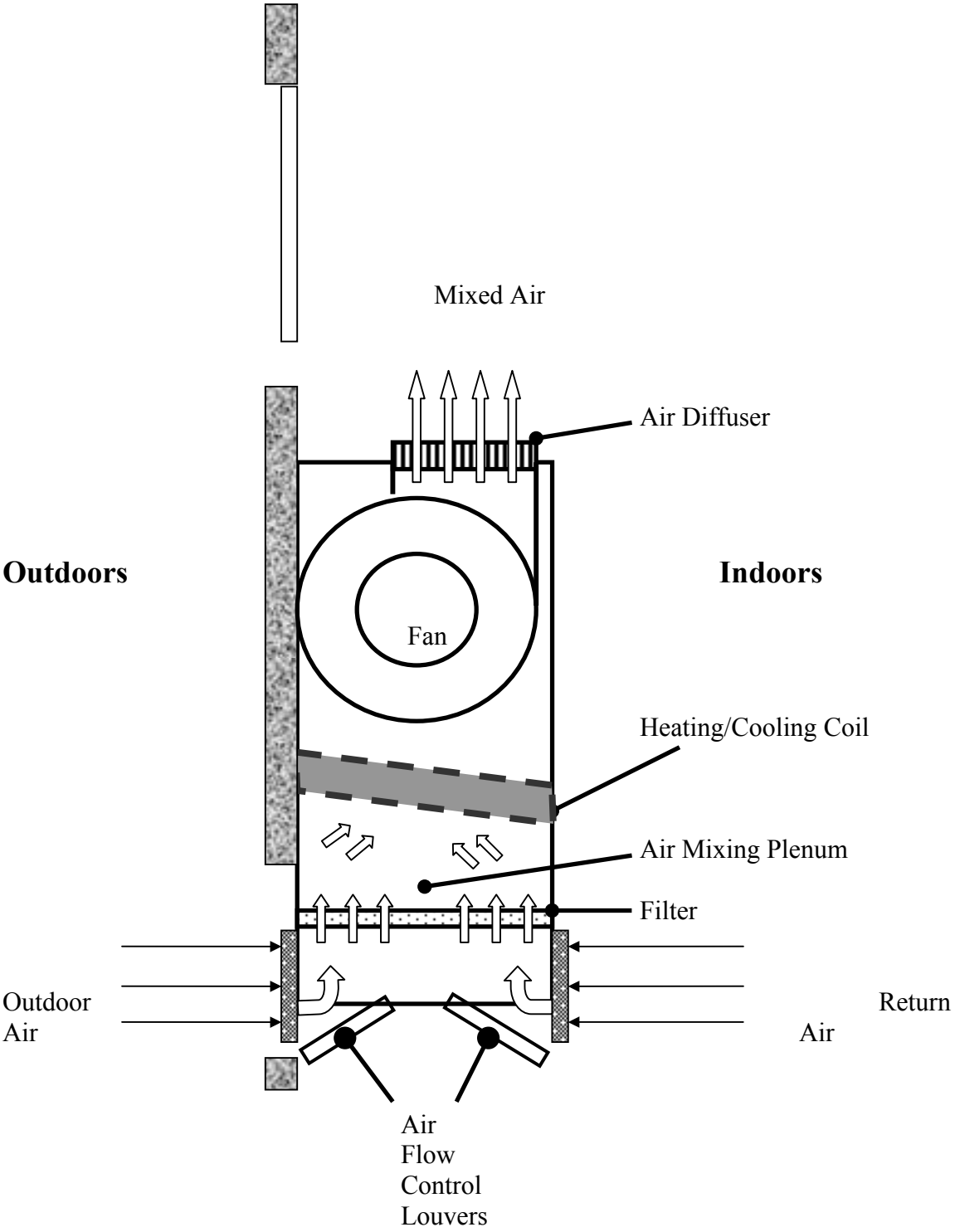
References

MDLWD. 1999a. Indoor Air Quality (IAQ) Survey 00S-0107, Salemwood Elementary School, Malden, MA, November 16, 1999. Department of Labor and Workforce Development, Division of Occupational Safety, West Newton, MA.

MDLWD. 1999b Indoor Air Quality (IAQ) Survey 00S-0094, Salemwood Elementary School, Malden, MA, December 14, 1999. Department of Labor and Workforce Development, Division of Occupational Safety, West Newton, MA.

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

Figure 1 **Unit Ventilator (Univent)**



1. Air Flow

⟵ = Fresh Air/Return Air

⇦ = Mixed Air

2. Picture 1

Gymnasium Fresh Air Supply Vents

Picture 2

Gymnasium Exhaust Vents Note Hanging Gym Divider at Left

Picture 3

Space under Boiler Room Doors

3. Picture 4

Example of Self-Contained Cleaning Solution Station in Custodial Closet

4. Picture 5

Example of Ceiling-Mounted Local Exhaust Vent in Custodial Closet

Picture 6

Aquarium in Classroom C-309 with Standing Water

5. Picture 7

1-Gallon Container of Hydrochloric Acid in Janitorial Supply Room A-117

Remarks	TVOC AM	TVOC PM	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
							Intake	Exhaust	
Outside-Main Entrance (Background)	0.3		70	74					Conditions: cloudy, rain, ventilation system turned off since previous evening
Main Lobby-outside Principal's Office	1.2	0.3	71	66					~10:30 AM
Cafeteria A	0.8		71	69	20				
Custodian's Storage A117	0.6	0.3	71	66					Wax stripper, hydrochloric acid
Boiler Room	0.7		74	65					Space under door
A107	0.5	0.3	72	63					Dry erase board
West corner-Outside	0.3	0.3	68	74					
A126 - Girl's Restroom									Construction debris, plugged toilet
A216 – Custodian Closet	1.1								
A213	0.8	0.5	70	71					
A206	1.1	0.7	71	67					Dry erase board
B209-Home Ec. Room	0.7		70	67					Electric stoves with hoods, vented dryer
B215-Custodian Closet	0.7		71	66					Water stained ceiling tile, standing water (drain clogged)
C209-Science Room	0.7	0.3	71	67					
Gym-NE Corner	0.3		71	67	15-20	No			"Shower Curtain" odor

Remarks	TVOC AM	TVOC PM	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
							Intake	Exhaust	
Gym-NW Corner	0.3		70	68		No			"Shower Curtain" odor
Gym-SW Corner	0.3		70	68	10-15	No			"Shower Curtain" odor
Gym-SE Corner	0.3		70	69		No			"Shower Curtain" odor
Gym-Center	0.3		69	69		No			"Shower Curtain" odor
C309-Science		0.2	73	64					Fan coil unit in chemical prep room, sinks, aquarium, hood
Library	0.3		72	62					